Third United Nations
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Abstract

# TRENDS OF ATOMIC POWER DEVELOPMENT
## (New economic data)

N.M.Sinev, B.B.Baturov, V.M.Shmelev

Leaving the experimental and research stage atomic power generation is now a practical feasibility and will play an important role in the power industry of several countries in the nearest future.

A wide-scale development of atomic power generation must be based on thorough scientifically substantiated advance planning.

Selection of the most effective version of atomic power development that would enable the best use to be made of the material and labour resources is a problem which has a paramount importance for the national economy.

This necessitates the comprehensive comparative analysis of economic efficiency with due consideration for the possible lines of atomic power development for many years to come.

The planned nature of the Socialist economy permits such an analysis not be confined to separate atomic power stations but to be made comprehensively within the framework of national or state economic plans taking into account the required tempoes of nuclear power development and the need for the setting-up of specialized industries.

The paper discusses the basic principles of this analysis and evaluates in a comparative way different versions of nuclear power development with reactors of various types.

The results of these analyses prompt a number of important conclusions as to the future trends of development of nuclear power generation.

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Abstract

# INTERNATIONAL COOPERATION IN THE DEVELOPMENT OF NUCLEAR REACTOR PROJECTS

I.D.Morokhov, V.S.Kandaritsky,
Yu.V.Arkhangelsky

A widespread interest in the problems of peaceful uses of atomic energy as a powerful means of scientific and technical progress is now evidenced in an ever-inceresing number of countries. The achievements scored in the recent years in this rapidly developing field of science and technology, utilization of atomic power in almost all of their branches which enabled various practical applications of this power in countries with different level of scientific and economic development all this has promoted and expanded international cooperation to a still larger degree.

Planning of research work in the field of nuclear physics, mastery of reactor engineering, training of personnel and of many young and initiative scientists - this is what is necessary to enable a number of new countries to place atomic science at the service of human progress.

The years which passed after the Second UN International Conference on the peaceful uses of atomic energy have witnessed a marked expansion of international ties and scientific and technical cooperation between the Soviet scientists and scientific establishments and the scientists and scientific establishments of various countries.

International scientific and technical cooperation of the USSR with other countries in the field of the peaceful uses of atomic energy extends virtually to all branches of science - from the building of atomic power plants, research reactors to the

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training of technical and scientific personnel, exchange of scientific and technical information and display of "Atom for peace" exhibitions.

The Soviet Union has concluded new agreements and expanded scientific and technical exchange with 22 foreign countries.

The first agreements on the problems of utilization of atomic power were concluded by the USSR with all socialist countries. These agreements provided for the rendering of assistance in setting up of large research centres equipped with modern facilities including experimental reactors and modern physical and radiochemical laboratories, and for training of the personnel in the USSR. The second stage of these agreements related to cooperation between the countries in the further development of joint scientific reaseach in nuclear physics and radiochemistry, in the use of isotopes for national economy, in the field of atomic power generation, in the development of new reactors. What is new in these agreements in that they envisage not only the rendering of assistance but also the carrying out of joint reseacn both on bilateral basis and within the framework of the Council or Mutual Economic Assistance. In the new agreements, such as those signed with Korean People's Democratic Republic, Ghana, Indonesia, Iraq the USSR undertakes to build, in these countries, research reactors, physical and radiochemical laboratories and to train national personnel to work in these centres.

The Joint Institute of Nuclear Research which was set up in the town of Dubna on the "open door" principle is succesfully fuctioning, its international associations are widening, its equipment and facilities are growing. The Joint Institute of Nuclear Research widely practices joint studies with the scientists from other countries.

The Soviet experts and scientists take an active part in international congresses, conferences and symposiums. A number of such conferences and symposiums were held in the Soviet Union.

Guided by the Lenin's principles of the foreign policy - the po licy of peace, friendship and cooperation with all countries and having

accumulated vast experience in international cooperation in the field of peaceful utilization of atomic energy the Soviet Union calls for the further development of the scientific and technical cooperation in this field. Persuing the policy of peace the Soviet people and the peoples of the Socialist countries warmly welcomed the signing of the Moscow Treaty on banning nuclear tests in atmosphere, in cosmic space and underwater as the first step towards the successful solution of the problem of general and complete disarmament.

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Abstract

# REVIEW OF RESEARCH REACTORS IN THE USSR

V.V.Goncharov et al.

Research reactors of various types and for various applications have been developed in the USSR.

The paper describes the main lines of the development on research reactors:

1. Development of a unique research reactor with a super-high neutron flux and the lines of the future development.

Reactor SM-2 operates at the design power of 50 mega-watts. A thermal neutron flux of $3.10^{15} n/cm^2$ sec has been obtained in the neutron "trap". The reactor is designed for production of transuranium elements and for carrying out physical and engineering research. The paper presents physical and operational characteristics of reactor SM-2.

2. Development of research reactors of new construction for testing fuel elements and materials (pressurized reactors, swimming-pool reactors).

The paper makes a comparative analysis of modern loop reactors, discusses the main engineering and physical problems involved in development and operation of such reactors, notes the essential features of new reactors which provide much better conditions for testing fuel elements and materials.

3. Increase of the neutron flux in the operating reactors and expansion of their experimental possibilites.

The paper describes the most important improvements made in the operating reactors with neutron fluxes of $10^{13} n/cm^2 sec$ and $10^{14} n/cm^2 sec$.

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Abstract

# RESEARCH ON HIGH TEMPERATURE PLASMA PHYSICS AND CONTROLLED THERMONUCLEAR FUSION IN THE USSR

L.A.Artsimovich

1. The principal problems defining the trends of research at the present stage:

a)Plasma containment methods providing its stability;

b) Effective methods of plasma heating.

2. The results of the theoretical investigation on stability problem; stability in magnetic bottles of open and closed types with constant fields. The theoretical analysis of radio-frequency field stabilizing effect.

3. The experimental investigation of adiabatic magnetic bottles of open type.

a) The analysis of a magnetic mirrow system (ion magnetron, Ogra et al);

b) Systems with hybrid fields providing magnetic field strength rise in all directions from the plasma area (PR-5 and other devices). The relation of containment time and plasma density and temperature.

4. Experimetal investigations on closed magnetic systems

a) Plasma heating in toroidal systems with a strong stabilizing longitudinal field (Tokomag type devices).

b) Development of magnetic mirrows based on the stellarator principle.

5. Studies on various new methods of plasma heating.

a) the experiments on turbulent plasma heating by radio-frequency fields.

b) experiments on magneto-acoustic and cyclotron resonance.

6. Research on plasma containment by radio-frequency fields (travelling wave systems, devices based on dynamic stabilization concept etc).

7. Some new results of research on plasma heating during fast pulsing processes with a large power release.

8. Methodic development.

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# USE OF POWERFUL RADIATION SOURCES IN CHEMICAL INVESTIGATIONS

N.A. Bach, V.V. Voevodsky, V.I. Goldansky and A.S. Shtan, et al

The paper gives a survey of results obtained in the USSR during the last 2-3 years in different branches of radiation chemistry.

It is concerned first with advances in the investigation of elementary processes and in general theory, dealing mainly in the field of gas phase processes with mass-spectrometric studies of ion-molecular reactions and dissociation of excited ions, in the condensed state with the transfer of excitation energy and direct investigation of ions and radicals. New effects in energy transfer through triplet state have been revealed, correlating electronic excitation levels and radiation stability. Electromagnetic interaction in excitation transfer has been considered and a concept of "orientons" advanced. A greater part, than supposed earlier, is shown to be played by ions and ion-radicals in the condensed phase. Theoretical concepts of processes limiting the accumulation of frozen radicals and other active particles under irradiation have been developed.

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By ESR and kinetic methods new data have been obtained concerning the nature and reactions of primary particles in the radiolysis of water. A quantitative study of radical diffusion and recombination permitted to explain regularities in the formation of molecular products and to estimate the size of spurs and the initial radical distribution.

Investigations of radiation-induced solid state polymerization of different monomers demonstrate an exceptional influence of the phase state. A number of processes are proved to occur directly in the solid, with considerable kinetic effects in the range of phase transitions. Probable mechanisms of polymerization in the crystalline and glass state are discussed. Considerable catalytic action of p-type semiconducting oxides upon the low-temperature polymerization of acrylonitrile, methyl metacrylate, etc. and a selective action of p- and n-type oxides on the propagation of anionic and cationic chains are demonstrated.

New possibilities in gas phase graft polymerization have been demonstrated, such as synthesis of organo-mineral materials, formation of combined fibres with oriented grafted layer, etc. Radiation-induced vulcanization of special types of rubbers permitted to obtain substances with unique properties. Processes based on radiation-induced curing of tyres and cross-linking of plastics, have been developed.

Effects occurring in polymers specifically during irradiation have been discovered and investigated, viz. reversible changes in mechanical properties and diffusion rate, some saturation phenomena, etc.

By means of combined irradiation and pyrolysis of some polymers, organic semi-conductors with controlled electrophysical properties varying in a wide range have been obtained.

Catalytic and other reactions, occurring under irradiation in heterogeneous systems, are reported, with special attention to processes in the adsorbed layer.

Possibilities of utilizing, in the tracks or by way of overall temperature increase, the heat released in nuclear reactions for endothermic chemical processes are discussed.